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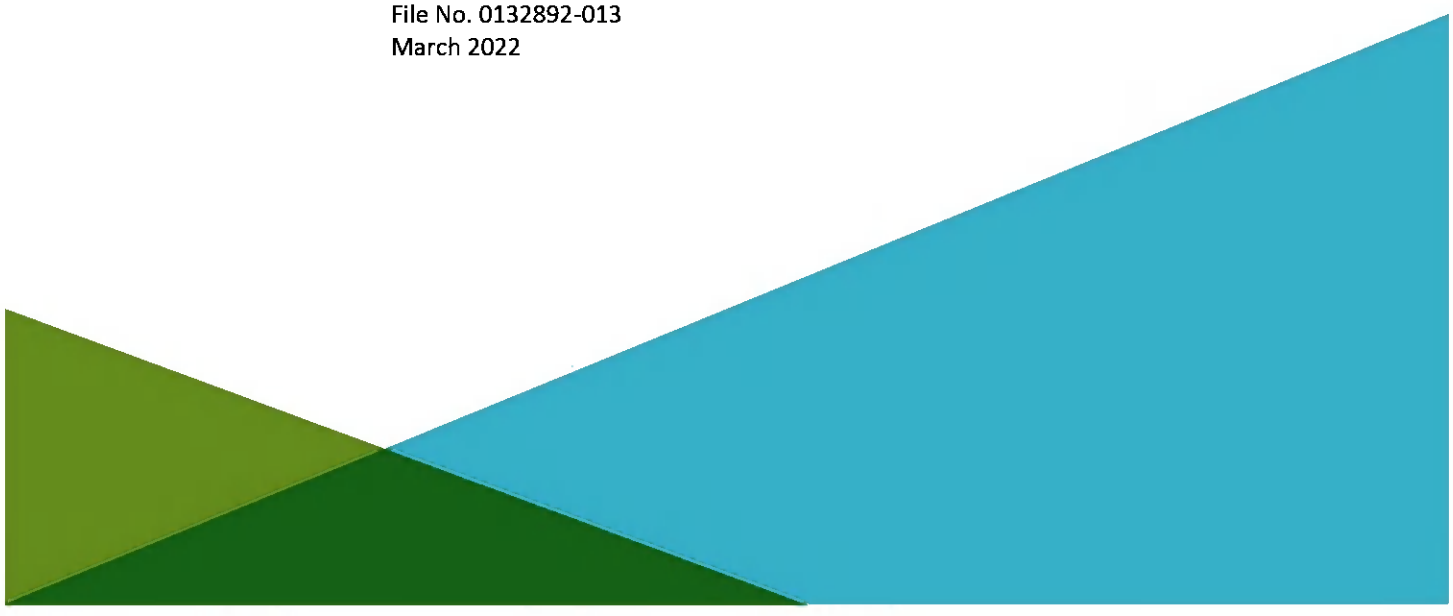
REPORT ON

SELECTION OF REMEDY
SANTEE-COOPER – WINYAH A & B ASH PONDS
GEORGETOWN, SOUTH CAROLINA

by
Haley & Aldrich, Inc.
Greenville, South Carolina

for
Santee-Cooper
Moncks Corner, South Carolina

File No. 0132892-013
March 2022



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30 March 2022
File No. 131539

Santee-Cooper
Monck's Corner, South Carolina

Subject: Selection of Remedy
Santee-Cooper, Winyah A & B Ash Ponds
Georgetown, South Carolina

Dear Jesse:

Haley & Aldrich, Inc. is please to submit this Selection of Remedy Report (Report) for Ash Ponds A and B at Winyah Generation Station. This Report was developed to comply with the United States Environmental Protection Agency (USEPA) Coal Combustion Residual (CCR) Rule.

We appreciate the opportunity to provide environmental consulting services on this project.

Sincerely yours,
HALEY & ALDRICH, INC.

Susan W Jackson, P.E.

Susan Jackson, P.E.
Senior Client Leader

Mark Miesfeldt

Mark Miesfeldt, P.G.
Senior Client Leader

Enclosures

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SELECTION OF REMEDY REPORT CERTIFICATION STATEMENT

Professional Engineer Certification: I, Susan W. Jackson, am a registered Professional Engineer in the State of South Carolina. I have reviewed the Selection of Remedy report for the Santee Cooper Winyah A and B Ash Ponds located in Georgetown, South Carolina and certify to the best of my knowledge, information, and belief that the information contained in this Remedy Selection Report dated 29 March 2022 was prepared in conformance with the requirements of the United States Environmental Protection Agency (USEPA) Coal Combustion Residuals (CCR) Rule entitled Hazardous and Solid Waste Management System; Disposal of Coal Combustion Residuals from Electric Utilities.

Susan W Jackson, P.E.

Susan W. Jackson, P.E. (25476)

2022 March 30

Date

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1. Introduction

1.1 OVERVIEW

South Carolina Public Service Authority (Santee Cooper) retained Haley & Aldrich, Inc. (Haley & Aldrich) to complete this Selection of Remedy Report (Report) for Ash Ponds A and B located at the Winyah Generating Station (WGS) in Georgetown, South Carolina in coordination with Santee Cooper. Santee Cooper is implementing the April 17, 2015, USEPA Federal CCR Rule (40 CFR §257) for WGS Ash Ponds A and B. In addition to Federal CCR Rule regulations, these surface impoundments are also regulated by the South Carolina Department of Health and Environmental Control (SCDHEC) under NPDES Permit #SC0022471.

This selection of remedy for WGS Ash Ponds A and B was completed according to the requirements of the USEPA CCR rule entitled Hazardous and Solid Waste Management System; Disposal of Coal Combustion Residuals from Electric Utilities. This Report concludes the corrective measures assessment process and will subsequently initiate the corrective measures implementation phase of the CCR Rule.

Ash Pond A and Ash Pond B are two CCR units within the same hydrogeologic system essentially located on an island surrounded by a permitted industrial wastewater cooling pond and an intake and discharge canal system. Accordingly, both CCR units are being addressed together in this Report. Assessment monitoring conducted in 2018 identified the presence of arsenic, lithium, and molybdenum in one or more downgradient wells at a statistically significant level exceeding the established groundwater protection standard (GWPS).

The GWPS are set as the Maximum Contaminant Level (MCL) of 10 µg/L for arsenic and the EPA Regional Screening Level (RSL) of 40 µg/L for lithium and 100 µg/L for molybdenum. As a result, Santee Cooper initiated the corrective measures assessment process including characterizing the nature and extent of arsenic, lithium, and molybdenum, continuing semiannual groundwater sampling, and issuing a corrective measures assessment (CMA) report. Haley & Aldrich, Inc. completed the CMA report which proposed six alternatives and discussed how each alternative met the threshold and balancing criteria outlined in the CCR Rule. Santee Cooper published the CMA report to its publicly available CCR Website. A public meeting was held 10 December 2019 at the Winyah Generating Station to discuss contents of the CMA in accordance with 40 CFR §257.96(e) and accepted comments during and after the public meeting.

The comments received related to the CMA were considered for the remedy selection. Subsequently, additional information to further characterize site conditions that could ultimately affect a remedy was obtained to further evaluate and support remedy selection. This included an update to the groundwater flow and solute transport model, site borings to determine the vertical extent of source removal, progress of on-going source removals, and ongoing groundwater sampling to evaluate changes in groundwater flow and concentration trends associated with CCR source removal operations.

1.2 PURPOSE

In accordance with 40 CFR §257.97(b), a remedy must satisfy the following threshold criteria:

(i) be protective of human health and the environment,

(ii) attain the groundwater protection standard as specified pursuant to §257.95(h),

(iii) control the source of releases to reduce or eliminate, to the maximum extent feasible, further releases of constituents in appendix IV into the environment,

(iv) remove from the environment as much of the contaminated material that was released from the CCR units as is feasible, considering factors such as avoiding inappropriate disturbance of sensitive ecosystems,

(v) comply with standards for management of wastes as specified in §257.98(d).

To select a remedy, six alternatives were evaluated based on the threshold criteria and then compared to three of the four balancing criteria listed in §257.97(c)(1), which include:

(i) The long- and short-term effectiveness and protectiveness of the potential remedy(s), along with the degree of certainty that the remedy will prove successful,

(ii) The effectiveness of the remedy in controlling the source to reduce further releases,

(iii) The ease or difficulty of implementing a potential remedy.

The fourth balancing criteria is the degree to which community concerns are addressed by a potential remedy.

Alternative 4 in the CMA Report is the selected remedial option. This corrective measure is a two-part approach consisting of closure by removal (CBR) of the CCR material and affected subsurface soil (determined based on an extensive field sampling and analytical program), followed by monitored natural attenuation (MNA) of arsenic, lithium, and molybdenum in groundwater. Pursuant to 40 CFR §257.97(a) and (d), this report describes the selected remedy, how it meets the criteria outlined above, and specifies a schedule for implementing and completing remedial activities.

1.3 SITE CHARACTERIZATION

WGS's geology and hydrogeology is described in the *Preliminary Site Hydrogeologic Characterization Study Report* prepared by Geosyntec in March 2015, *Site Hydrogeologic Characterization Study Report* prepared by Geosyntec in August 2016, and in the *NPDES Groundwater Monitoring Plan* prepared by Santee Cooper in December 2010.

The preliminary and final *Site Hydrogeologic Characterization Study Reports* prepared by Geosyntec were to satisfy SCDHEC landfill permit application requirements to construct a new Class 3 Landfill. Santee Cooper conducted investigations to collect geologic, hydrologic, and geotechnical data to better define the best locations for a landfill and to conduct groundwater modeling. Ash Ponds A & B were included in these investigation efforts, and a portion of Ash Pond A was selected for the footprint of the Class 3 Landfill Area 2.

Geosyntec geologists used Doar's (2012) geologic descriptions to categorize the subsurface soils at the WGS and its surrounding areas into: fill soils, unconsolidated Pleistocene sediments, and Williamsburg Formation sediments. The Chicora Member can be present in the upper portion of the Williamsburg Formation and can contain cemented layers (cemented Chicora) ranging from several inches to several feet in thickness.

Generally, the Site hydrogeologic conditions consist of unconfined surficial aquifer consisting of mixtures of predominantly sand and minor amounts of silt and clay. The surficial aquifer at the site also includes the permeable portion of the Gordon Aquifer which is represented by the cemented and non-cemented Chicora Member of the Williamsburg Formation. The Chicora overlies the dense, low permeability dense clays of the Williamsburg Formation and is sporadic at the Site; however, the dense clays of the Williamsburg Formation are continuous and extend to a minimum elevation of at least -60 ft NGVD. Groundwater flow within the surficial aquifer is controlled by the onsite ponds and regional topography and is generally toward the Pennyroyal and Turkey Creeks. Additional details of the hydrogeologic conditions are in the Geosyntec Site Hydrogeologic Characterization Reports.

These studies generated subsurface data characterizing the geology and hydrogeology used to support the development of a hydrogeologic Conceptual Site Model (CSM). The CSM has been further enhanced with ongoing CCR groundwater monitoring and supplemental subsurface investigation activities performed by Haley & Aldrich. Findings from these investigations have added to the CSM that supports the Corrective Measures Assessment (CMA) Report.

1.4 GROUNDWATER MONITORING

Groundwater monitoring under the CCR Rule occurs through a phased approach to allow for a graduated response (i.e., baseline, detection, and assessment monitoring, as applicable) and evaluation of steps to address groundwater quality. Haley & Aldrich prepared a Groundwater Monitoring Plan (GMP) as required by the CCR Rule. The GMP presented the design of the groundwater monitoring system and groundwater sampling and analysis procedures.

To monitor Ash Pond A & Ash Pond B, downgradient wells were installed along the perimeter of the units. Haley & Aldrich concluded that two previously existing downgradient monitoring wells, WAP-9 and WAP-10, located at the boundary of the units, and screened in the uppermost aquifer, adequately monitor the release and migration of ash constituents from Ash Ponds A & B. To supplement these wells and comply with the Rule, three additional wells were installed around Ash Pond A (WAP-17, WAP-18, and WAP-19) and two additional wells were installed around Ash Pond B (WAP-20 and WAP-21). Well placement was determined based on interpretations of site-specific hydrogeology including groundwater flow direction and rate of groundwater movement under operating conditions. Refer to Figure 1 for a map of well locations for Ash Ponds A & B.

Baseline and detection monitoring sampling events occurred in 2015, 2016, and 2017. The results of the sampling events were compared to background, or natural groundwater values, using statistical methods to determine if Appendix III constituents downgradient of the units were present at concentrations representing statistically significant increases (SSI) above background. All Appendix III constituents were detected at SSIs above background concentrations (boron, calcium, chloride, pH, sulfate, and total dissolved solids were SSIs in all seven downgradient monitoring wells, while fluoride was only an SSI in wells WAP-18, WAP-19, and WAP-20) (Figure 1- Well Location Map).

Haley & Aldrich conducted an alternate source evaluation for the SSIs found at Ash Ponds A & B. This evaluation included a review of sampling procedures, laboratory procedures, and statistical analyses to determine if potential errors may have been made to that would result in the apparent SSI; potential point and non-point sources of contamination in the vicinity of Ash Ponds A & B; and observed natural geochemical conditions that could affect the natural variability of groundwater quality. The April 2018 report concluded that there were no apparent alternate sources that could account for the apparent SSIs found at Ash Ponds A & B. Thus, assessment monitoring was initiated for both units.

During the assessment monitoring phase, CCR groundwater samples were collected in June and September 2018 and subsequently analyzed for Appendix III and IV constituents in accordance with §257.95(b) and §257.95(d)(1). After establishing GWPS for the Appendix IV constituents, a statistical analysis of the assessment monitoring results was conducted to determine if the detected Appendix IV constituents were present in groundwater at statistically significant levels (SSL) above the GWPS. This analysis produced SSLs for arsenic (WAP-9, WAP-17, WAP-18, WAP-19, and WAP-20), lithium (WAP-9, WAP-17, WAP-18, WAP-19, and WAP-20), and molybdenum (WAP-20). The GWPS are the MCL of 10 µg/L for arsenic and the EPA RSL of 40 µg/L for lithium and 100 µg/L for molybdenum. As a result, Santee Cooper initiated the corrective measures assessment process including conducting a nature and extent characterization, continuing groundwater sampling, and issuing a CMA report.

1.5 CORRECTIVE MEASURES ASSESSMENT PROCESS

The CMA process involved review of groundwater remediation technologies that will achieve the threshold criteria stated in Section 1.2. To develop appropriate remedial alternatives, a nature and extent investigation was initiated in 2019 prior to the development of the CMA report.

The nature & extent investigation was initiated with the installation of five additional monitoring wells to further delineate the site vertically and horizontally: one downgradient at the boundary of Ash Pond A (WAP-22), two downgradient at the boundary of Ash Pond B (WAP-23 and WAP-24), and two downgradient on the perimeter of the industrial Cooling Pond (WAP-25 and WAP-26). The three wells installed at the boundary of Ash Ponds A & B were designed and constructed to vertically delineate the extent of the SSLs to supplement the existing monitoring wells which provide horizontal delineation. The two wells installed along the perimeter of the Cooling Pond were designed and constructed to horizontally delineate the extent of SSLs to the north and east of Ash Ponds A & B along the Site's property boundary.

Analytical results to date for two of the three nature & extent wells constructed downgradient of Ash Ponds A & B (WAP-23 and WAP-24) indicate that arsenic, lithium, and molybdenum are not detected above GWPS in a deeper aquifer that is hydraulically disconnected by a layer of clay. Likewise, analytical results to date for the nature & extent wells constructed along the perimeter of the Cooling Pond (WAP-25 and WAP-26) indicate that arsenic, lithium, and molybdenum are not detected above GWPS at the property boundary. Arsenic and lithium were detected above GWPS in monitoring well WAP-22 in its first sampling event after installation in June 2019; analytical results since then have been below GWPS. The final CMA Report was placed in the operating record in September 2019.

2. Assessment of the Fourth Balancing Criteria

After the development of the CMA report, the remedy selection process continued by holding a public meeting to discuss the proposed alternatives for corrective measures. Pursuant to 40 CFR §257.96(e), *"The owner or operator must discuss the results of the corrective measures assessment at least 30 days prior to the selection of remedy, in a public meeting with interested and affected parties."* A public meeting was conducted at Winyah Generating Station on December 10, 2019. Notices were published in the local newspaper and signs were installed in advance of the meeting at Winyah's entrance. Adjacent property owners were notified of the public meeting. Six alternatives from the CMA were presented at the public meeting in which the public was invited to comment. Verbal comments expressed support of the preferred alternative without dissention. Only one written public comment was received, which was in favor of the selected remedy: *"Excellent to remove the ash from these unlined pits." – Southern Environmental Law Center.*

The CMA addressed the first three balancing criteria. These comments were considered for assessment of the fourth balancing criterion listed pursuant to 40 CFR § 257.97(c)(4) of the CCR Rule which states: *"...the degree to which community concerns are addressed by a potential remedy(s)."* Consideration of the comments supports the selected remedy.

3. Progress Since Completion of the Corrective Measures Assessment

During the interim period between the issuance of the corrective measures assessment report and the issuance of this Remedy Selection Report, semi-annual progress reports were prepared and posted on Santee Cooper's publicly accessible website describing the progress in selecting and designing the remedy.

In addition to the public meeting, the following is a list of activities supporting the selection of remedy completed by Santee Cooper since the publication of the CMA with further explanation below:

- Conducted assessment monitoring through ongoing semiannual groundwater sampling consistent with 257.95(b) and (d)(1).
- Continued an aggressive beneficial use schedule to reduce the volume of CCR on-site.
- Sited, permitted, and constructed additional disposal areas of an on-site Subtitle D Class 3 landfill for CCR disposal. Construction activities required abandonment and replacement of three groundwater monitoring wells.
- Developed a sampling and analysis plan to determine the extent of CCR and soil removals which included obtaining South Carolina Department of Health and Environmental Control (SCDHEC) approval of the methodology.
- Implemented the sampling and analysis plan to delineate the bottom of the CCR (i.e., ash/soil interface) via multiple borings and to determine the extent of soil excavation. Map the bottom of the ash and the subsurface soils for removals through visual observations of the borings and laboratory analysis of the soils.
- Updated the groundwater flow and transport model to evaluate potential changes in groundwater flow related to pond closure and landfill construction activities. Specifically, the model anticipated future site conditions once Ash Ponds A and B are closed by removal and a Subtitle D Class 3 landfill is located in a portion of the Ash Pond A footprint.
- Assessed metrics for monitoring groundwater remediation progress for lithium, molybdenum, and arsenic.

Assessment monitoring continued to identify the same Appendix IV constituents at SSLs above GWPS. No additional constituents were identified. In fact, some decreasing trends are being observed for arsenic, lithium, and molybdenum as dewatering and removal of the CCR source material continues for either beneficial use or disposal in an on-site Class 3 landfill.

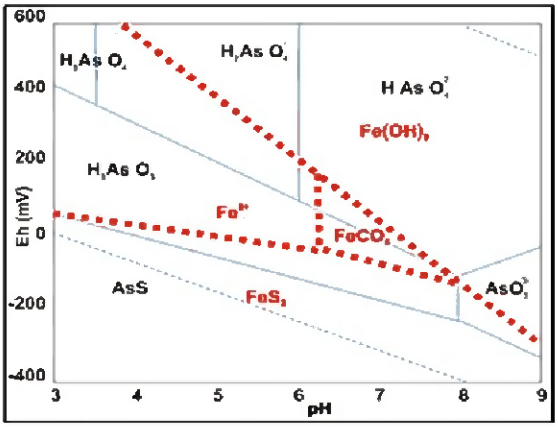
In 2020 and 2021, a sampling and analysis plan was implemented to determine the extent of CCR and CCR contaminated soils required for source removal. This information was needed to confirm feasibility of removal of the volume of material and to plan for dewatering and other operational considerations based on the depth of material to be removed. The bottom of ash and soil samples were collected by drilling borings within the ash pond footprint. A Geoprobe® drilling rig was used to obtain the soil samples. SCDHEC approved the boring workplan in February 2020 and the contractor was on site May through July 2020 to collect the borings and soil samples. The soil cores were visually assessed to determine the depth of the ash/soil interface and to select sampling intervals for analysis. Soil samples were collected and sent to a certified laboratory for analysis. Laboratory analyses were completed by February 2021. The depth to which contaminated soil will be removed was determined by analyzing the soil for a specified list of constituents so that the soil remaining in place does not pose an unacceptable

risk to human health and the environment. The soil sample results for each analyte were compared to established target levels which are specified values derived from the comparison of EPA risk-based regional screening values and background soil concentrations. The soil results, evaluation, and recommended soil excavation depth was compiled and submitted to SCDHEC in a phased approach: Ash Pond A #1 in November 2020 (approved December 2020), Ash Pond B in May 2021, Ash Pond A #2 in September 2021, and Ash Pond A #3 in December 2021 (approved February 2022). To date, SCDHEC has not completed their review nor provided comments on the submittal packages for Ash Pond A #2 or Ash Pond B. SCDHEC must approve the soil excavation plan as required by state regulations R.61-82, Proper Closeout of Wastewater Treatment Facilities.

Because of on-going activities regarding source removal for beneficial use, landfill, and/or landfill construction activities, site conditions are dynamic. Since the original model was set up to simulate operating conditions, the groundwater flow and solute transport model was updated by Haley & Aldrich to evaluate potential changes in groundwater flow related to pond closure and landfill construction activities. Specifically, the model simulated a condition where the Ash Pond A, and then Ash Pond A and B combined were closed by removal of CCR, backfilled with a layer of clean soil, then capped with a Class 3 landfill in 65 acres of the 90-acre Ash Pond A.

The remedy includes not only full source removal, but also monitored natural attenuation (MNA) of arsenic, lithium, and molybdenum in the groundwater. On-going groundwater monitoring, combined with statistical trend analysis, and geochemical evaluations will be the primary metrics used to evaluate the performance of the remedy following CBR. For example, this evaluation will include comparing arsenic concentrations to the Oxidation Reduction Potential (ORP) as seen in Figure 2 and comparing the lithium concentration data to the lithium groundwater predictive model as seen in Figure 3. To provide this additional metric for evaluating lithium, the 2019 CMA groundwater model was updated to include a closer examination of the remediation of lithium once closure by removal and landfill construction was complete based on the updated groundwater flow and solute transport model. If actual post-closure concentrations vary significantly from predicted values, additional site-specific investigations and/or remedy enhancements will be taken into consideration.

In the 2019 CMA report, lithium was modeled as a surrogate for molybdenum and arsenic to evaluate and compare time frames to achieve the GWPS for the six alternatives. Lithium was chosen as the surrogate for the 2019 CMA report because it was detected above the GWPS in both Ash Pond A and B, and it has a higher degree of mobility compared to arsenic. The CMA model evaluates and predicts remediation trends when the primarily attenuation mechanisms are dilution, dispersion, and adsorption. Because the primary mechanism for arsenic remediation at this site appears to be mineral precipitation (co-precipitation) and secondarily dilution, dispersion, and adsorption, the CMA model was determined to not be an appropriate tool to predict the reduction of arsenic over time. As previously indicated, groundwater flow and quality conditions surrounding these units is in a state of flux and dewatering for source removals and landfill construction are underway. Groundwater monitoring results from wells located closest to these operations have shown an increased in the ORP. This increase in Eh correlates with a decrease in the arsenic concentrations consistent with the arsenic solubility diagram below.



Arsenic Solubility

Arsenic and ORP trends will be evaluated on an ongoing basis with semi-annual groundwater sampling and analysis. If needed once the site has stabilized, a geochemical groundwater model may be developed using site specific information. Molybdenum was not modeled because it intermittently meets the GWPS and there is an outlier in the data. Molybdenum is being monitored to determine if the outlier was a one-of due to landfill construction activities in the area or indicative of evolving site conditions.

4. Selection of Remedy

4.1 REMEDIAL OPTION

Alternative 4 in the CMA Report is the selected remedial option. It is a two-part approach consisting of closure by removal (CBR) of the CCR material and a scientifically determined volume of subsurface soil, followed by monitored natural attenuation (MNA) of arsenic, lithium, and molybdenum in groundwater. In accordance with §257.97, this alternative has been evaluated in the context of, and subsequently meets, the threshold and balancing criteria as described in Section 1.2. Additionally, in accordance with §257.97(c), this alternative has been evaluated in the context of the required factors compared to the other five alternatives evaluated in the CMA report.

4.1.1 Part 1: Closure-by-Removal

Closure-by-removal is a form of source control. In fact, the CBR for Ash Ponds A & B will not only remove the CCR material, but a predetermined amount of underlying soil as well. As previously noted, determining the quantity of ash remaining in the ponds and the extent of soil removal necessary to achieve SCDHEC remediation goals have been completed (partially pending SCDHEC approvals). These remediation goals were defined so that residual soil remaining in place would not pose an unacceptable risk to human health or the environment. The total CCR quantity expected to be removed from Ash Ponds A & B is approximately 4.2 million tons. Additionally, the total soil quantity anticipated to be removed from Ash Ponds A & B is approximately 406,000 tons.

Any CCR material that will not be beneficially reused due to time constraints to complete closure and meet beneficial use contractual obligations will be disposed in an on-site Class 3 landfill meeting state and federal design standards. The Class 3 Landfill was sited, permitted, designed, and constructed on-site at WGS. The Class 3 Landfill Area 1 is primarily being used for disposal from Ash Pond A. The construction of the Class 3 Landfill Area 2 is ongoing and is located within the footprint of Ash Pond A in areas that source removal has been completed and approved by SCDHEC. This portion of the landfill was sized to contain the full quantity of Ash Pond B plus the CCR material and soils to be excavated from other on-site ponds.

Together, the beneficial use program and the on-site disposal capacity makes the option of CBR extremely viable and ultimately controls the source by eliminating further releases to the groundwater, removes contaminated solid waste, and complies with the standards of waste management.

4.1.2 Part 2: Groundwater

Upon removal of the source (i.e., all CCR material and delineated underlying soil), the second component of the selected remedial alternative addresses groundwater improvements through MNA. MNA is a viable remedial technology recognized by both state and federal regulators that is applicable to inorganic compounds in groundwater when the primary source has been removed. Lines of evidence were evaluated to confirm that site constituents can be remediated via MNA. First, historical trends show concentrations are generally observed to be decreasing with on-going source removals and dewatering. Second, geochemical data (Figure 2) indicates subsurface conditions are amenable to MNA, specifically increasing ORP is consistent with observed decreases in arsenic.

After completion of CCR and subsurface soil source removals, MNA is expected to reduce concentrations of arsenic, molybdenum, and lithium in groundwater at the boundary of Ash Ponds A and B thereby attaining the GWPS. Over time, the removal remedy allows concentrations of these constituents in downgradient groundwater to attenuate through adsorption, precipitation, dispersion, and dilution. This will be determined by continuing to monitor and evaluate using the metrics described in Section 3. Because the combined Ash Pond A & B is surrounded by the 400-acre closed-loop industrial cooling pond complex, groundwater extending beyond the boundary of the waste has the potential to discharge into the on-site permitted wastewater treatment system. This cooling pond treatment system has the capacity to handle the mass-loading from groundwater discharges without causing reasonable potential to impair receiving waters.

A corrective measures groundwater monitoring program will be prepared and implemented in accordance with §257.98, to document the effectiveness of the selected remedial option. Corrective measures are considered complete when groundwater monitoring reflects that the SSL constituent concentrations in groundwater downgradient of the Winyah Ash Ponds A & B do not exceed Appendix IV GWPS for three consecutive years.

As the USEPA modifies certain CCR Rule requirements and, depending upon the nature of such changes, assessments made herein could be modified or supplemented to reflect such future regulatory revisions.

4.2 ATTAINMENT OF THE THRESHOLD CRITERIA

40 CFR §257.97(b) specifies that the selected remedy must attain certain threshold criteria. The following sections explain how the selected remedy meets these criteria.

(i) Be protective of human health and the environment

The constituents of concern are confined to the WGS site and the uppermost aquifer which is not used for drinking water purposes. For the uppermost aquifer, drinking water receptors have not been identified within a quarter mile of Ash Ponds A and B based on a 2011 Receptor Survey. Drinking water is supplied by Georgetown County Water and Sewer District (GCWSD) to Winyah Generating Station. Adjacent property owners are supplied by GCWSD except for a community well (Water System SC2220002, GCWSD Kilsock Water System) which is located north of WGS beyond the quarter mile radius of Ash Ponds A and B. Groundwater monitoring at select locations at the property boundary will continue.

The on-site industrial cooling pond and canal system fully surround the Ash Ponds A and B, and this water body has the capacity to handle the mass-loading from groundwater discharges without causing reasonable potential to impair receiving waters. Because of these reasons, human health and the environment are adequately protected.

(ii) Attain the groundwater protection standard as specified pursuant to §257.95(h).

Following completion of closure by removal, a corrective action groundwater monitoring program will be established in accordance with §257.98(a)(1). The arsenic, lithium, and molybdenum concentrations are expected to continue to decline through chemical and physical processes of natural attenuation that occur without human intervention. The effectiveness of the corrective measure will be evaluated by comparing semi-annual

groundwater monitoring results to the GWPS, evaluating expected decreasing trends of arsenic to corresponding increasing ORP, and comparing lithium decreases to the modeled predicted decreases. Short-term increases in Appendix IV concentrations may be observed during the CCR excavation and landfill construction process. Maintaining the ponds in a dewatered state during excavation should help minimize short-term increases or variability but may not completely prevent them. Concentrations will continue to be monitored in the context of a longer-term trend analysis.

(iii) Control the source(s) of releases to reduce or eliminate further releases into the environment

Removing CCR material and underlying soil from the pond achieves this criterion. The CCR material and underlying soil will be either beneficially used or disposed in an on-site Class 3 Landfill, which has been designed, constructed, and is operated to be compliant with the CCR Rule and SC DHEC requirements. Completely removing the source will not only reduce but eliminate any further releases into the environment.

(iv) Remove as much of the contaminated material that was released from the CCR units as is feasible considering factors such as avoiding inappropriate disturbance of sensitive ecosystems.

Following source removal, the mass of constituents available to leach into groundwater will have been eliminated and continuance of contamination to the surrounding environment should not occur. Dissolved concentrations will attenuate through adsorption, precipitation, dispersion, and dilution. The on-site industrial cooling pond wastewater treatment system has the capacity to handle the mass-loading from groundwater discharges without causing reasonable potential to impair receiving waters. The Cooling Pond discharge outlet is covered under an existing NPDES permit. Groundwater will continue to be monitored to assess the post-closure groundwater concentrations until GWPSs are achieved for a minimum of three years.

(v) Comply with the standards for management of wastes as specified in §257.98(d).

CCR material and underlying soil will be either beneficially used or disposed in a Class 3 Landfill which is designed to meet CCR Rule standards and SC DHEC requirements. Both options meet RCRA requirements.

4.3 ATTAINMENT OF THE BALANCING CRITERIA

The remedy selection process included consideration of balancing criteria set forth in §257.97(c). The following sections explain how the selected remedy will meet these criteria and are summarized in Figure 4.

(i) Long- and Short-Term Effectiveness, Protectiveness, and Certainty of Success

The selected remedy meets this criterion because the CCR source is completely removed from the environment. Santee Cooper's longstanding beneficial use program had reclaimed material from Ash Pond A for years. Contracts with transportation services and end use markets have been secured and executed since 2015, with over 350,000 tons being removed each year to meet contract terms. Alternate disposal capacity has already been

permitted for an on-site landfill and construction is in progress and completed for several areas. The landfill's capacity was designed to meet disposal requirements for CCR material and underlying soil that cannot be beneficially used in the 5-year closure period. This remedy has low long-term residual risk because CCR is being removed from the environment. An additional protectiveness measure associated with complete source removal is reducing the potential for liquefication because WGS is in a seismic hazard area. Groundwater is being addressed in-situ without ex-situ treatment and/or discharge, and thus the risk associated with managing secondary waste streams is eliminated. There are no mechanical systems as part of the selected remedy, therefore there is no major operation or maintenance beyond maintaining the integrity of the monitoring wells.

(ii) Source Control Effectiveness

This criterion takes into consideration the ability of the remedy to control a future release and the degree of complexity of treatment technologies that will be required. The source will be controlled by removing the CCR material plus contaminated soil underlying the units, thereby eliminating the further release of arsenic, lithium, and molybdenum or other constituents into groundwater.

(iii) Ease of Implementation

While closure by removal can be labor intensive, Santee Cooper's longstanding beneficial use program had been reclaiming material from ash ponds for years. Contracts with transportation services and end use markets have already been secured and executed since 2015, with over 350,000 tons being removed each year to meet contract terms. To facilitate closure within 5 years, this volume will increase. To accommodate this increase in volume, alternate disposal capacity has already been permitted for an on-site landfill and construction is in progress. Specialty equipment is also not required to conduct closure by removal or MNA.

(iv) Addresses Community Concerns

As noted in Section 2, this criterion was addressed December 10, 2019, when a public meeting was held on site at Winyah Generating Station and verbal and written comments were received and heavily considered. The selected remedy was received favorably by the public without dissent.

4.4 REMEDY IMPLEMENTATION AND SCHEDULE

WGS presents materials management challenges that may impact the implementation and closure timeframes for the CBR alternative. CCRs in Ash Ponds A & B will be dewatered to remove free water before being hauled to, and placed in, the future on-site lined Class 3 Landfill and/or beneficially used. The extent of the required removals was determined through extensive borings and sampling and analysis of the underlying soil below the CCR material. After excavation and removal of the CCR, visual confirmation of the ash removal will be conducted.

Technical and logistical challenges of implementing a large-scale ash removal project have been considered. Removal activities require dewatering and temporary staging/stockpiling of material for drying prior to transportation, which may affect productivity and increase removal duration. During periods of rain and inclement weather, the removal schedule will be impacted negatively. Excavation

and construction safety during the removal duration is another concern due to heavy equipment (e.g., bulldozers, excavators, and front-end loaders) and dump truck operation within the active WGS site. The factors outlined in §257.97(d) were considered in the development of the schedule for design, implementation, and completion of the selected remedy. See Tables 1 – 3 for schedule details. All dates are approximate and convey the overall sequence, scope, and duration of closure activities. Activities may commence or complete earlier or later than shown. The schedule is aggressive with the end dates driven by regulatory requirements.

(i) Nature and Extent of Contamination

Arsenic, lithium, and molybdenum have only been observed in downgradient wells at the boundary of the waste. SSLs of Appendix IV constituents have not been observed in downgradient wells at the property boundary. The selected remedy addresses the nature and extent of contamination observed at Ash Ponds A & B, which is supported by groundwater modeling and is expected to be supported by future groundwater sampling results.

(ii) Reasonable Probability of Remedial Technologies in Achieving Compliance

Complete source removal, in combination with MNA, is expected to achieve compliance with the CCR Rule and meet the GWPS in the long-term. This conclusion is supported by observance of general decreasing trends for arsenic, lithium, and molybdenum concentrations in some wells, increasing ORP in combination with decreasing arsenic concentrations supports mineral precipitation as the process contributing to the reduction in arsenic, and groundwater model simulations for lithium. The flow and solute transport model may be periodically updated, or recalibrated if needed as groundwater monitoring continues and actual post-closure groundwater flow and quality conditions are more clearly defined.

(iii) Availability of Treatment or Disposal

As discussed previously, adequate disposal capacity will be available upon the completion of construction of the on-site Class 3 Landfill. Additionally, MNA relies on natural attenuation process which do not rely on the availability of ex-situ treatment technologies that generate secondary waste streams.

(iv) Potential Risks to Human Health and the Environment

Impacts of arsenic, lithium, and molybdenum at the site have been delineated and no off-site migration of impacts have been observed based on groundwater monitoring. Because there are no off-site impacts and the uppermost aquifer on-site or in the immediate vicinity of WGS is not used for human consumption, potential risks to human health and the environment are not affected in a way that would influence remedy implementation or the schedule. Additionally, MNA requires less equipment and labor than most other methods such as pumping groundwater to the surface for above ground treatment so the potential for contact is limited. On-going groundwater monitoring will continue until the groundwater protection standards are met.

(v) Resource Value of the Aquifer

The resource value of the aquifer is not affected in a way that would influence the remedy implementation schedule. The uppermost aquifer is not currently used for drinking water or for other known commercial or industrial uses. Future known uses are not planned for this aquifer at this time. Drinking water receptors have not been identified within a quarter mile of Ash Ponds A & B. Georgetown County Water & Sewer District supplies drinking water to nearby residents, except for a community well located north of WGS. WGS may obtain water from the aquifer below the Crouch Branch confining unit (well screen is located 410-462 feet below ground surface) for emergency industrial operations through a groundwater withdrawal permit. The groundwater quality is expected to continue to improve over time as the remedy is implemented. The extent of the delineated impacted groundwater aquifer is not expected to cause damage to wildlife, crops, vegetation, and physical structures caused by exposure to CCR constituents. The groundwater aquifer is in an industrial area that does not have adjacent commercial crops. The hydrogeologic characteristics of the site have been considered throughout the corrective action process.

4.5 CONCLUSION

The selected remedy of closure by source removal of CCR and a pre-determined extent of subsurface soil with MNA meets the CCR Rule requirements as described above. Santee Cooper will comply with §257.98 – Implementation of the Corrective Action Program.

References

1. Geosyntec Consultants, 2015. *Preliminary Site Hydrogeologic Characterization Study Report, Santee Cooper Winyah Generating Station, Georgetown, South Carolina*. March.

2. Geosyntec Consultants, 2016. Site Hydrogeologic Characterization Study Report, Santee Cooper Winyah Generating Station, Georgetown, South Carolina. February.

3. Haley & Aldrich, 2019. *Corrective Measures Assessment, Santee Cooper Winyah Generating Station, Georgetown, South Carolina*. September.

4. Haley & Aldrich Technical Memorandum, *2022 Groundwater Modeling Update, Winyah Generating Station, Ash Ponds A & B*. 18 March.

5. Kestrel Horizons, LLC, 2011. *Receptor Survey Results, Winyah Generating Station, Georgetown, South Carolina*. June.

6. Santee Cooper, 2010. *NPDES Groundwater Monitoring Plan*. December.

7. U.S. EPA, 2015. Use of Monitored Natural Attenuation for Inorganic Contaminants in Groundwater at Superfund Sites. U.S. Environmental Protection Agency Office of Solid Waste and Emergency Response, Directive 9283.1-36. August.

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TABLES

TABLE I
SANTEE-COOPER WGS ASH POND A REMEDY IMPLEMENTATION SCHEDULE
WINYAH A & B ASH PONDS
MONCK'S CORNER, SOUTH CAROLINA

Ash Pond A Remedy Implementation Activity	Estimated Completion Date
Beneficial use to reduce volume of CCR material in Ash Pond A prior to initiating closure & during closure activities	ongoing to meet beneficial use contracts and facilitate source removals
Submit CCR State Closure Plan to SC DHEC for approval	Completed – November 2020
Final receipt of waste and wastewater & Notification of Intent to initiate closure	Completed – April 2021
CCR removal from Ash Pond A (to Landfill Area 1)	Completed – March 2022
Complete construction of Class 3 Landfill Area 2 concurrent with CCR and soil removal from Ash Pond A (to Landfill Area 1)	December 2022
Closure activities for Ash Pond A (i.e., remaining grading and breach dikes)	December 2022
Semiannual groundwater monitoring under Corrective Action Monitoring Plan Continue to monitor the success of the selected remedy and revise as needed.	Begin January 2023 until GWPS met
Notification of closure completion under CCR Rule[1]	Once GWPS are met consecutively for 3 years

Notes:

1. *Closure notification 30 days after closure complete. Closure is complete when groundwater meets groundwater protection standards.*

TABLE II
SANTEE-COOPER WGS ASH POND B REMEDY IMPLEMENTATION SCHEDULE
WINYAH A & B ASH PONDS
MONCK'S CORNER, SOUTH CAROLINA

Ash Pond B Remedy Implementation Activity	Estimated Completion Date
Final receipt of waste and wastewater & Notification of Intent to initiate closure	Completed – April 2021
Submit CCR State Closure Plan to SC DHEC for approval	Completed – May 2021
Complete construction of Class 3 Landfill Area 2	December 2022
CCR removal from Ash Pond B (to Landfill Area 2)	January 2022 – April 2025
Conduct semiannual groundwater monitoring under Corrective Action Monitoring Plan	July 2025 until GWPS met
Further Decontamination Activities for Ash Pond B (e.g., grading and breach dikes)	December 2025
Notification of closure completion under CCR Rule[1]	Once GWPS are met consecutively for 3 years

Notes:

1. *Closure notification 30 days after closure complete. Closure is complete when groundwater meets groundwater protection standards.*

TABLE III
STATE PERMITTING ACTIVITY SCHEDULE
WINYAH A & B ASH PONDS
MONCK'S CORNER, SOUTH CAROLINA

Required State Permitting Activities Concurrent with CCR Closure	Estimated Completion Date
Receive SCDHEC Approval on CCR State Ash Pond A Closure Plan	Completed December 2020[1]
Receive SCDHEC Land Disturbance Permit for Borrow Pit (Landfill Material)	Completed – April 2021
Receive SCDHEC approval to operate Landfill Cells 4 & 5	Completed – December 2021
Receive SCDHEC approval on CCR State Ash Pond A Closure Plan Addendum	April 2022
Receive SCDHEC approval on CCR State Ash Pond B Closure Plan	December 2022
Receive SCDHEC approval to operate Landfill Cells 6 & 7	December 2022
Notify SCDHEC of closure completion for Ash Pond A under State Closure Plan	December 2022
Notify SCDHEC of closure completion for Ash Pond B under State Closure Plan	December 2025
State Post-Closure Care Groundwater Monitoring	In accordance with Post-Closure Permit

Notes:

1. *SCDHEC only approved the state closure plan as written for the landfill footprint. An addendum to the state closure plan was requested by SCDHEC and submitted for their review in September 2021. This addendum discusses closure plan activities for Ash Pond A outside of the landfill footprint and SCDHEC approval is required to complete soil removal activities in this area.*

FIGURES

LEGEND

- BACKGROUND WELL
- ASH POND B MONITORING WELL
- PROPERTY BOUNDARY WELL

ASH POND A MONITORING WELL

- ABANDONED
- EXISTING
- REPLACEMENT
- CCR UNIT BOUNDARY
- PROPERTY BOUNDARY

NOTES

1. ALL LOCATIONS AND DIMENSIONS ARE APPROXIMATE.
2. AERIAL IMAGERY SOURCE: ESRI

N

0 1,000 2,000

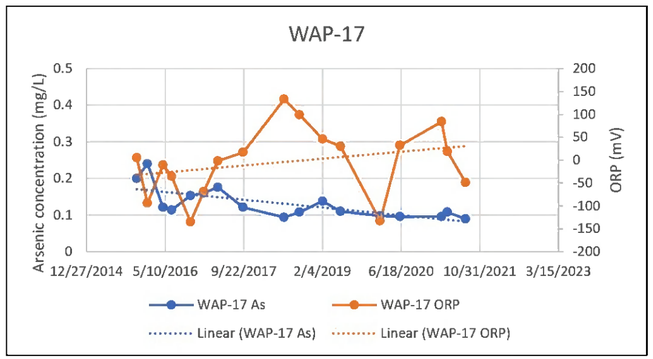
SCALE IN FEET

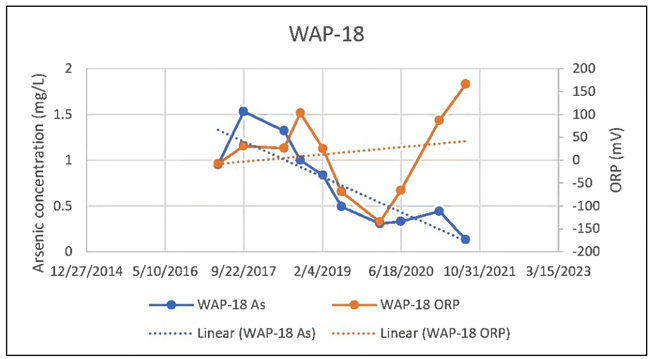
SANTEE COOPER
WINYAH GENERATING STATION
GEORGETOWN, SOUTH CAROLINA

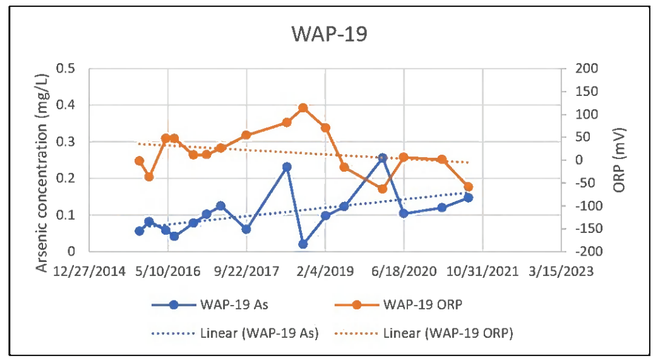
LOCATION OF ASH POND A & B GROUNDWATER MONITORING WELLS FOR CCR COMPLIANCE

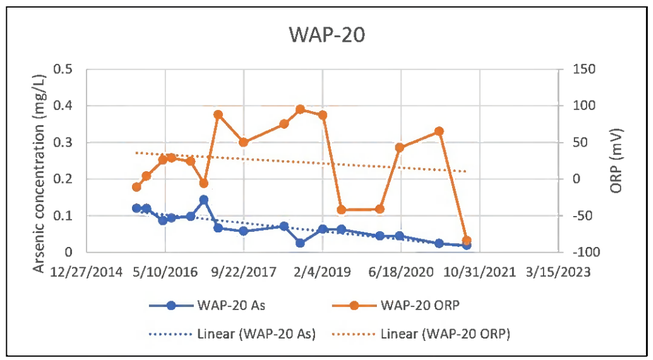
JANUARY 2022

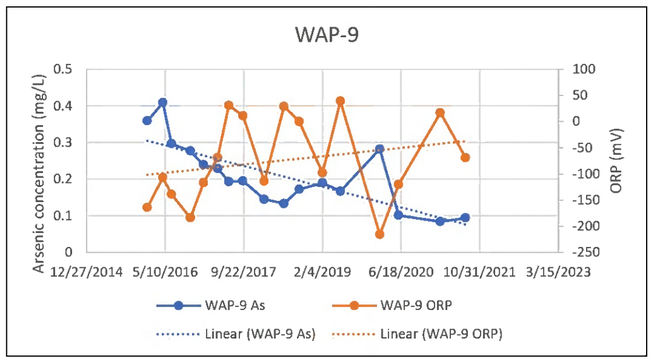
FIGURE 1

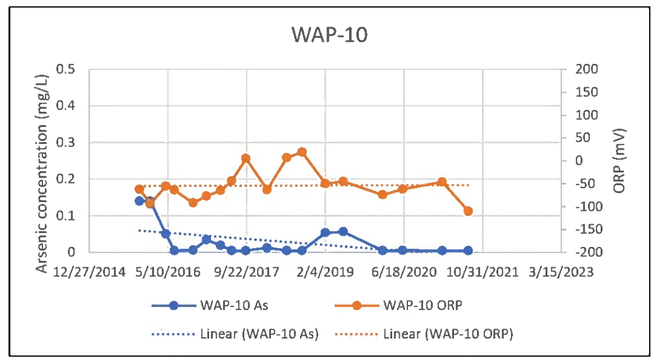












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Trend Graphs
Winyah Generating Station
Ash Pond A & B Groundwater Model
Update Georgetown, South Carolina

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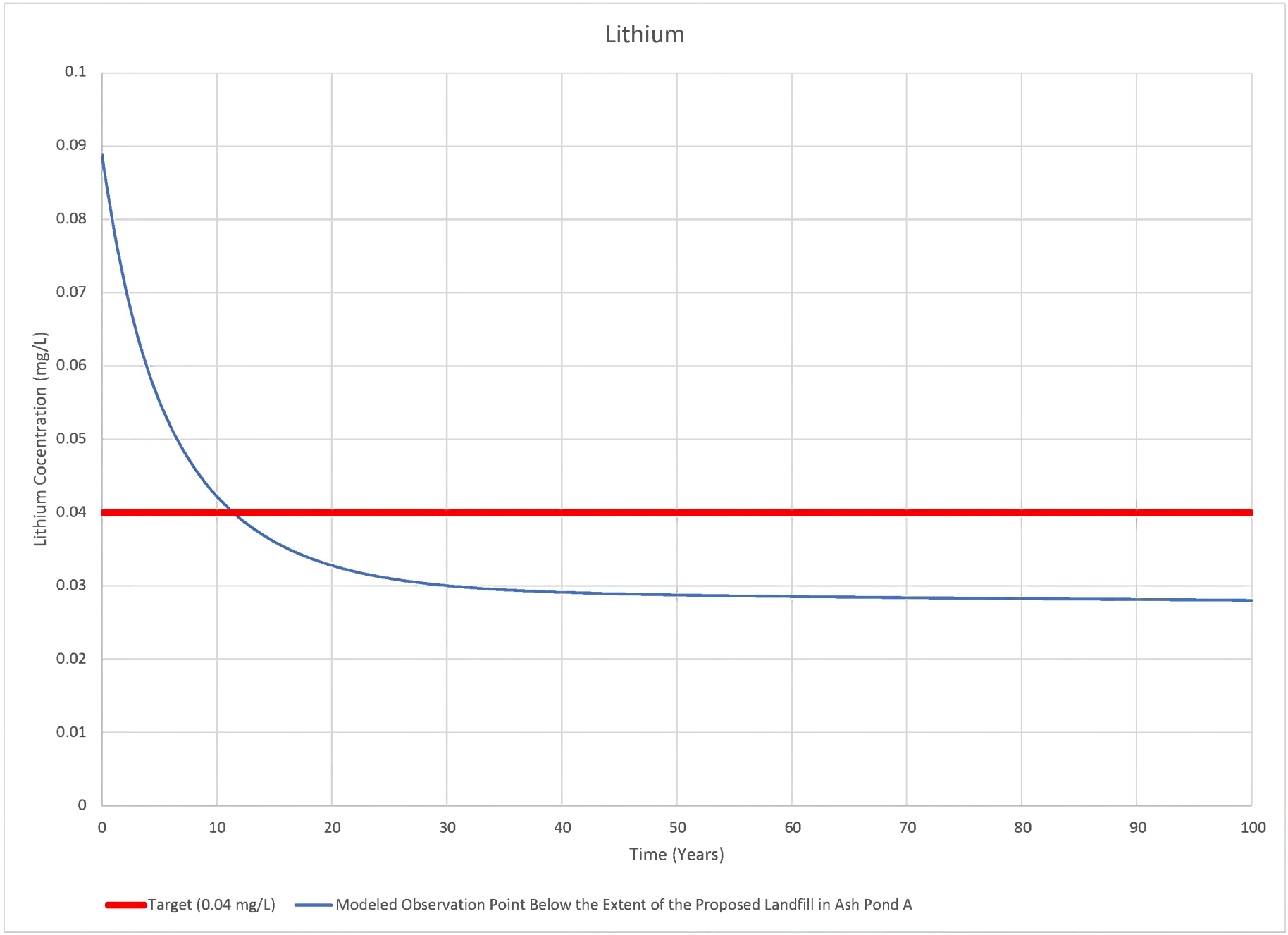
MARCH 2022 **FIGURE 2**



HALEY ALDRICH

March 2022

Groundwater Model Output-Lithium
Winyah Generating Station
Ash Pond A & B Groundwater Model Update
Georgetown, South Carolina

FIGURE 3

FIGURE 4: SUMMARY OF CORRECTIVE MEASURES

SANTEE COOPER – WINYAH ASH PONDS A & B

Alternative Number	Remedial Alternative Description	THRESHOLD CRITERIA					BALANCING CRITERIA			
		Be protective of human health and the environment	Attain the groundwater protective standard	Control the source of releases	Remove from the environment as much of the contaminated material that was released from the CCR unit as feasible	Management of waste in accordance with RCRA requirements	CATEGORY 1 Long- and Short-Term Effectiveness, Protectiveness, and Certainty of Success	CATEGORY 2 Effectiveness in Controlling the Source to Reduce Further Releases	CATEGORY 3 Ease of Implementation	CATEGORY 4 Consideration of Community Concerns*
1	Closure in Place (CIP) with Capping and Monitoring & Natural Attenuation (MNA)	✓	✓	✓	✓	✓	Effective short-term & long-term, groundwater monitoring used to verify MNA	Moderate effectiveness to control further releases but not as good as beneficial use due to ash being left in place	Relative ease to implement. Permitting expected to be straightforward.	Comment #1: "Excellent to remove the ash from these unlined pits." – Southern Environmental Law Center
2	CIP with Capping and Hydraulic Containment through groundwater pumping and direct discharge	✓	✓	✓	✓	✓	Effective short-term; long-term requires ongoing operations & maintenance	Moderate effectiveness to control further releases but not as good as beneficial use due to ash being left in place; still a risk of release from the hydraulic discharge	More difficult to implement due to more complexity. Permitting will be required.	
3	CIP with Capping and Hydraulic Containment through groundwater pumping and ex-situ treatment	✓	✓	✓	✓	✓	Effective short-term; long-term requires ongoing operations & maintenance	Moderate effectiveness to control further releases but not as good as beneficial use due to ash being left in place; still a risk of release from the treatment system chemicals and treatment media	[redacted]	
4	Closure by Removal (CBR) with MNA	✓	✓	✓	✓	✓	Effective short-term & highly effective long-term since ash is being removed from the environment and success is certain	Moderate effectiveness short-term (beneficial use is ongoing & successful), high degree of long-term release control	Relative ease to implement & straightforward permitting; however, volume of material takes time to move	
5	CBR with Capping and Hydraulic Containment through groundwater pumping and direct discharge	✓	✓	✓	✓	✓	Effective long-term but requires ongoing operations & maintenance to manage hydraulic discharge	Eliminates long-term releases; still a risk of release from the hydraulic discharge	More difficult to implement than above due to more complexity. Permitting will be required.	
6	CBR with Capping and Hydraulic Containment through groundwater pumping and ex-situ treatment	✓	✓	✓	✓	✓	Effective long-term but requires ongoing operations & maintenance to manage treatment system; short-term effectiveness not certain	Eliminates long-term releases; still a risk of release from the treatment system chemicals and treatment media.	More difficult to implement due to more complexity. Logistical and safety challenges expected	

Most favorable when compared to other alternatives

Less favorable when compared to other alternatives

Least favorable when compared to other alternatives

Santee Cooper's selected alternative is No. 4.

*Public comments were received during the public meeting held December 10, 2019.

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